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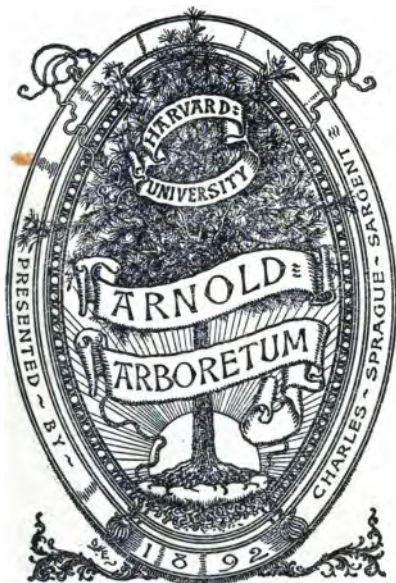
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~~DEPOSITED AT THE  
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MARCH, 1967

THE INFLUENCE  
OF  
OUR NORTHERN FORESTS  
ON  
THE MISSISSIPPI RIVER.

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BY  
S. WATERHOUSE,

OF  
WASHINGTON UNIVERSITY.

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St. Louis, March 1. 1892.

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## The Importance of our Northern Woodlands to the Navigation of the Mississippi.

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If the water that now flows in the Mississippi were contracted into a narrow channel, it would, even in mid-summer, be amply sufficient for all the purposes of navigation. But any material reduction in the volume of water would seriously increase the difficulties which now confront the Government engineers. If the axe of the northern woodsman is lowering the Mississippi and its upper tributaries, Congress ought at once to enact forestry laws that will effectively protect those woodlands which are still under the national control. That the felling of large forests affects the distribution of the rainfall both reason and observation seem to prove.

As long as the present constitution of nature exists, the moisture ceaselessly carried into the air by the process of evaporation *must* return to the earth. Does the presence or absence of trees make any difference in the quantity of rain that falls in a given district? The range of comparative observation has been too limited for science at present to give a definite response to this inquiry. But it seems reasonable to believe that the chill of evaporation tends to condense the humidity of the atmosphere and again to slake the thirst of the trees with the water transpired from their leaves, or wind-borne from distant sources. It is well known that the functions of both animal and vegetable life develop electricity, and it is highly probable that the growth of plants produces electrical conditions that favor precipitation. This is consistent with the infinite wisdom which cosmic processes everywhere exhibit. It would be strange indeed, if nature, which makes such marvelously ingenious provisions to preserve the life of all the rest of its children, should neglect its vegetable offspring.

The geographies studied in my childhood asserted that it never rained in Egypt. During the first day of my visit to that land, there were two showers. They fell in the neighborhood of the Suez Canal. But the quantity of water in that canal was altogether too insignificant to account for the result. Apart from the construction of this great waterway, there have been for ages no physical changes except the recent growth of a large number of trees and the cultivation of limited tracts on the banks of the canal. It would appear to be a legitimate inference that the showers were due to the trees and the tillage. It is a proverb among farmers that the clearing of woodlands causes those springs that are not fed from remote sources to dry up. In New England, some of the streams that fifty years ago were large enough to drive mills have, since the removal of the neighboring woods, dwindled to mere brooklets. The deforestation of northern Maine has heightened the spring freshets and lowered the mid-summer flow of the rivers. Many streams that were once deep enough to float logs to the mills have become too shallow for the lumbermen to use. It is said that the waters of our great northern lakes are gradually sinking.

There is no apparent explanation of this subsidence, except the wide-spread destruction of forests around the sources of the tributary rivers. The rains pass off in sudden floods, and do not, by slow filtration through the soil, maintain the level of the lakes by a relatively steady and evenly distributed inflow.

It has been stated that the rain-gauge shows that there is no greater amount of precipitation on wooded than on bare lands. If the *same* showers pass over both tracts, the statement is probably true; but it is my *belief* that, in the case of large sections, the forests are more frequently watered than the prairie.

But grant that the precipitation is the same in both instances. What follows? It is necessary to

trace merely the results of the rainfall in the summer season, for that is the time when low water embarrasses navigation; and to speak only of large areas, for small ones would not exert a perceptible influence on the climate.

The soil of the northwest, in which the Mississippi has its sources, is largely a clayey loam. When it is unprotected by the shade of trees, the heat of a summer sun bakes the surface into a hard crust. Unless the rains are protracted, and they seldom are in the warm months, they fail to soften the crust and penetrate deeply into the soil. If the surface is uneven, most of the water flows quickly into the streams and is borne away from that region. If the surface is level, the intense heat causes rapid evaporation. Moreover the radiation of a large body of heated land rarefies the air and creates thirsty winds which greedily absorb moisture. In consequence of the rapid off-flow and evaporation, comparatively little water is stored in the soil of an unwooded district.

But lands shaded by forests are not sun-scorched. The ground remains friable. Most of the rain is absorbed into the porous earth. Unless the showers are very heavy, the immediate flow into the streams is relatively small.

The cool forests do not engender hot winds, but break those which come from the open plains; the trees ward off the solar heat with their leafy shields; and the exhalation of moisture from the foliage lowers the temperature of the woodland. All of these conditions tend to check evaporation from the soil. A large part of the humidity of forest-clad grounds passes into the air by transpiration, but the woodlands, even after they have satisfied the intemperance of the trees, contain a greater quantity of moisture than that which shadeless and sun-dried fields absorb; and this water, slowly percolating through the earth, feeds the springs and maintains the rivers.

Doubtless tillage tends to counteract the bad effects of cutting forests. The plow, the cultivator, and the shade serve to keep the soil mellow, and the rains would sink deep into the earth. In the comparison of crops with woods, evaporation would be greater, and transpiration less; for even the most luxuriant maize would not break the force of hot winds as effectively as trees would, while the extent of the cereal leafage would be far less than that of the sylvan foliage. If it is true that, since the colonial times, there has been no material decrease in the rainfall of New England, the fact is unquestionably attributable to a cultivation which is nearly coextensive with the cleared lands. But this condition of general tillage does not prevail in the remote northwest. In that almost uninhabited region, there is scarcely one cultivated acre to the square mile. Consequently the plowed clearings are too limited perceptibly to counteract the injurious effects of felling the forests.

In a brief discussion of the climatic conditions which affect the stage of water in the Mississippi, it is quite unnecessary to advert to the influence which mountain ranges, irrespective of woods, exert upon precipitation, inasmuch as there are no mountains near the sources of the Mississippi.

With an equality of conditions in area, temperature, friability, and rainfall, it seems probable that there would be a greater exhalation of moisture from the cleared than from wood land. There is less evaporation in the shade than in the open air; and the trees only exhale the water which comes to their roots by the mysterious process of diffusion.

In the densest forest, the roots occupy only a small portion of the ground, but diffusion is active among all the atoms of the soil. It would certainly seem that the free evaporation from the whole surface of the ground would be more rapid than transpiration through foliage of moisture drawn from relatively limited spaces. Under the assumed con-



ditions, unless the absorbent force of capillary attraction is vastly greater than the diffusive energy of the soil, the amounts of transpiration and evaporation would approximately correspond to the proportion that subsists between the areas of the roots and of the given tract.

Even in the most respectable and civilized climates, there are surprising instances of misbehavior. Turbulent cyclones create tumults in the most peaceful and best ordered states of the atmosphere. But, though there are apparent exceptions to the normal action of the elements which it baffles the present efforts of science to explain, these uncommon phenomena do not at all impair our confidence in the general stability of natural laws. The constancy with which nature provides for the wants of vegetable life would seem to justify the belief that the showers which refresh the woodlands are more frequent than those that water the open plains. But it is certain that, even if the forests do not increase the rainfall, they at all events insure its slow and useful distribution. This is a highly important fact which statesmen desirous of improving the navigability of the Mississippi river cannot afford to ignore. The importance of the subject invites the grave consideration of our national legislators. If more stringent forestry laws would at all serve to maintain the volume of the Mississippi, then Congress would be faithless to its duty, if it failed to enact them. A judicious preservation of northern woodlands might perhaps prevent the expenditure of additional millions in deepening the channel of the river. The improvement of the Mississippi is now a sufficiently arduous undertaking, without the increased difficulties with which a still lower stage of water would invest the problem.

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